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OF THE

ELISHA MITCHELL SCIENTIFIC SOCIETY

1899

SIXTEENTH YEAR PART SECOND

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ON THE UNIVERSAL DISTRIBUTION OF TITANIUM.[1]

BY CHARLES BASKERVILLE.

The universal distribution of titanium in the mineral and plant world is practically acknowledged. V. Roussel[2] found it in basalt; Aleksiejew[3] in certain clays. Holland[4] found it in certain igneous rocks. Dunnington[5] observed its occurrence in the soil of Albemarle County, Va.; later the same writer with McCaleb[6] found it in sixteen specimens of soil collected from different sections of the United States. Subsequently after having examined a large number of samples of soil collected from all parts of the globe Professor Dunnington[7] asserted its universal occurrence in the soils of the world.

W. A. Noyes[8] found it in a number of Arkansas minerals. Hillebrand has shown its presence in a large number of rocks and minerals collected by the United States Geological Survey. Wait[9] found it in the ashes of several plants and different

[1] *J. Am. Chem. Soc.*, *XXI*, *1099*.
[2] *Ber. d. chem. Ges.*, *6*, *1417*, *b*.
[3] *Chem. Ztschr.*, Rep. 1896, 261.
[4] *Chem. News*, *59*, *27*.
[5] *Proc. A. A. A. S.*, *34*, *132*.
[6] *Am. Chem. J.*, *10*, *36*.
[7] *Am. J. Sci.*, Dec., 1891; *Chem. News*, *65*, *65*.
[8] *J. Anal. Appl. Chem.*, *5*, *39*.
[9] *J. Am. Chem. Soc.*, 18, 402.

kinds of wood, also in coals, bituminous and anthracite. Haywood[1] found traces in domestic strawberries and 0.1088 per cent. in the ash of wild strawberry (*Fragaria Virginiana*). Langenbeck speaks frequently of its occurrence in clays. It has been found by the writer rather widely distributed in the clays of this state.[2] While Roscoe and Schorlemmer state that "It does not appear to form a part of the animal and vegetable kingdom," Wait[3] assumes that it is assimilated by plants. The writer[4] shows its presence in peat. As the clay substance therein is comparatively small its presence can scarcely be attributed to that. F. Garrigon found traces in mineral waters.

No statement in the literature has been found of its presence being noted in the ashes obtained from the animal kingdom. The ash from incinerated fresh beef, beef bone, human flesh, and bone free from dirt, have been examined in this laboratory with the following results: Beef bone 0.0195 per cent.; beef flesh 0.013 per cent.; human bone[5] a trace; human flesh[6] 0.0325 per cent. titanic oxide.

A private communication from Dr. J. L. Howe concerning the work of some of his students states that "Toole found titanium in abundance in dead bones, but only traces in fresh bone and muscular tissue, though traces were undoubtedly there." Dr. C. E. Wait in a letter of recent date writes: "Since my note on titanium was published a year or so ago, I have made an examination of a large number of bodies and I believe that the element was found in nearly all of them. I have made a large number of estimations of titanium in vegetable bodies, and later took up the examination of animal

1 This laboratory. Work unpublished.

2 See "Clay Deposits and Clay Industry in N. C." Bulletin 13, N. C. Geological Survey, by Dr. H. Ries.

3 *Vide supra.*

4 *J. Am. Chem. Soc.*, 21, 706.

5 A true rib and clavicle.

6 Pectoral muscles, *latissimus dorsi* and *gluteus maximus*. I am indebted to Dr. C. S. Mangum, of this University, for kindly dissecting out these samples.

flesh and bone, and the last piece of work along that line was the examination of human excretory products."

The universal distribution of titanium in all forms of living and dead matter may now be regarded as settled. While no opinion is hazarded by the writer upon the role played by titanium in animal and vegetable growth, it is hoped that Dr. Wait's work will throw some light upon the subject. Doubtless had we as delicate and convenient tests for the other less common elements we should find their occurrence as widespread. Thus the asseverated belief of Hillebrand in the universal occurrence of the elements in the earth's crust is extended.

Titanium was determined by Weller's well-known method as modified by W. A. Noyes, Dunnington, and Hillebrand.[1]

THE OCCURENCE OF VANADIUM, CHROMIUM, AND TITANIUM IN PEATS.[2]

BY CHARLES BASKERVILLE.

Attention has been called by Dr. W. F. Hillebrand[3] to the comparatively wide-spread occurrence of vanadium in a large number of minerals and rocks. He states that "Hayes in 1875 reported its occurrence in a great variety of rocks and ores. Quoting from Thorpe's 'Dictionary of Chemistry,' 'it is said to be diffused with titanium through all primitive granite

[1] Method ascribed to Noyes was previously published by F. W. Clark in *Silliman's Journal, 1868.* (Letter to writer.)

[2] Read before the North Carolina Section of the American Chemical Society at the midwinter meeting. Publ. *J. Am. Chem. Soc. 441, 706.*

[3] *Am. J. Sci., 6, 209 (1898).*

rocks (Dieulafait) and has been found by Deville in bauxite, rutile, and many other minerals, and by Bechi and others in the ashes of plants and in argillaceous limestones, schists, and sands.....' It is further reported to comprise as V_2O_5 0.02–0.07 per cent. of many French clays, 0.02–0.03 per cent. of some basalts, 0.24 per cent. of a coal of unknown origin, and 0.45 per cent. of one from Peru, amounting to 38.5 per cent. and 38.0 per cent. of the ash, and noted respectively by Mourlot and Torrico y Meca."

Roussel[1] states that a basalt with a content of 0.707–2.378 per cent. of titanium contained 0.006–0.023 per cent. of vanadium. Gladstone,[2] however, states that it does not occur in the volcanic dust of Vesuvius. Terreil[3] found it in iron ores. Stolba[4] also mentions its occurrence.

From the above the presence of vanadium could with reason be suspected in peat. In the hands of the writer were samples of peats from Hyde Swamps, one mile south of Pungo Lake near the Northern Junction of Beaufort and Hyde Counties, N. C. The approximate analysis of these peats gave:

Sample.	Water.	Volatile matter.	Fixed carbon.	Ash.
Peat I	73.67	16.16	9.72	0.45
Peat II	71.58	17.42	10.31	0.69
Peat III	76.01	14.19	9.32	0.48

The water was determined by taking a cube measuring about eight cm. each way (from 700 to 800 grams) and bringing to a constant weight by heating for a number of hours not higher than 105° C. An analysis, approximate, of this dried peat gave the following results:

Sample.	Volatile matter.	Fixed carbon.	Ash.
Peat I	61.38	36.90	1.72
Peat II	61.35	36.20	2.45
Peat III	59.13	38.85	2.02

It was convenient to examine the ash of a large number of

1 *Ber. d. chem. Ges.*, *6*, *1417 b.*
2 *Ibid.*, *5*, *815 b.*
3 *Ibid.*, *10*, *731 a.*
4 *Chem. Centrbl.* (*1897*), *121.*

peats from this and other localities to ascertain the presence of titanium. We have found no statements regarding the presence of this element in these ashes, although such a surmise was logical. Neither does chemical literature, as far as we have been able to examine, give any mention of the occurrence of chromium in peats. Appended are the results of seeking for these elements in the samples mentioned above.

Sample.	Titanic oxide.	Chromium sesquioxide.	Vanadium pentoxide. Percentages in ash.
Peat I	0.490	0.0283	0.00107
Peat II	0.340	0.0343	0.0026
Peat III	0.491	0.0355	0.0031.

In determining titanium the ash was decomposed according to the method of W. A. Noyes,[1] namely, by fusion with sodium fluoride and potassium pyrosulphate. The melt was brought into solution with Dunnington's[2] necessary precaution in mind: *viz.*, having from five to ten per cent. of sulphuric acid present. Hydrogen dioxide was added according to Weller's[3] well-known method and the titanium determined colorimetrically. All hydrofluoric acid was driven off in the fusion and the hydrogen dioxide was free from that acid as well. Hillebrand[4] has shown the necessity for this.

Chromium[5] and vanadium[6] were estimated according to the latest method of Hillebrand.

A STUDY OF CERTAIN DOUBLE CHROMATES.

BY W. G. HAYWOOD.

Zehenter has stated (Monatshefte f. chemie 18. 48–55 Cen-

[1] *J. Anal. Appl. Chem.*, *5*, *39*.
[2] *J. Am. Chem. Soc.*, *13*, *210*.
[3] *Ber. d chem. Ges.*, *15*, *2592*.
[4] *J. Am. Chem. Soc.*, *17*, *718*; *Chem. News*, *72*, *158*.
[5] *J. Am. Chem. Soc.*, *20*, *454*.
[6] *Ibid.*, *20*, *461*; *Am. J. Sci.*, *6*, *209*.

tral Blatt. 97.I.857) that when a boiling solution of potassium bichromate is neutralized with sodium carbonate according to this equation,

$$K_2Cr_2O_7 + Na_2Co_3 = K_2CrO_4 + Na_2CrO_4 + CO_2 ;$$

then concentrated over the direct flame and over sulphuric acid, first the double salt $3K_2CrO_4.Na_2CrO_4$ will crystallize out in the form of flat or column-shaped crystals, then a salt of the same composition with one half molecule of water and finally yellow crystals of the salt $Na_2CrO_4.4H_2O$. The sodium chromate prepared by Johnson which crystallized with ten volumes of water was not obtained. Zehenter also prepared the salts $3K_2CrO_4.2(NH_4)_2CrO_4$ and $NaNH_4CrO_4.2H_2O$ by precipitation with alcohol from the appropriate solutions.

For my experiments the following solutions were prepared :

1. 100 grams of potassium bichromate were dissolved in water and neutralized with sodium carbonate.

2. 100 grams of sodium bichromate were dissolved in water and neutralized with potassium carbonate.

3. 100 grams of ammonium bichromate were dissolved in water and neutralized with sodium carbonate.

4. 100 grams of sodium bichromate were dissolved in water and neutralized with ammonium carbonate.

5. 200 grams of potassium bichromate were dissolved and neutralized with sodium carbonate (repeating No. 1).

6. 110 grams of potassium bichromate and 98 grams of sodium bichromate were dissolved in hot water and evaporated.

7. 67 grams of potassium chromate and 60 grams of potassium carbonate were dissolved and evaporated.

8. 100 grams of potassium bicarbonate were dissolved and neutralized with magnesium carbonate.

9. 100 grams of potassium chromate and 55 grams of sodium carbonate were dissolved in hot water.

All of these solutions were concentrated and then placed over sulphuric acid for crystalization. The crops of crystals were carefully separated, washed, dried between filter paper and analyzed.

In the case of this solution (1) the crystals which first formed were found to contain a good deal of carbon dioxide. It was evident that the solution had not been exactly neutralized by the sodium carbonate but that an excess had been used. With successive crops the amount of carbon dioxide decreased and of chromium increased. Although the analysis of the third and fourth crops approached nearly to that of the double chromate reported by Zehenter, traces of carbon doxide were found throughout, and so another solution was prepared and more carefully neutralized. But the evident crystallizing together of the chromate and carbonate raised the question as to the possible formation of a body of exact composition containing these two. In the case of solution (1) the first crop of crystals was practically all chromate and the seventh and later crops again strongly carbonate. In solution (7) when potassium chromate and potassium carbonate were mixed several crops of crystals were gotten, the first being almost pure chromate and the latter carbonate, the two showing little tendency to crystallize together.

In solution (2) the 3rd crop of crystals gave 27.45 percent. Cr.; 4th crop, 28.10; 5th crop, 27:15; 6th crop, 28.03. There was a failure in this case also to prepare crystals of definite composition.

From solution (3) three crops of very deliquescent brown crystals were gotten which corresponded in composition to the formulas $2Na_2CrO_4.(NH_4)_2CrO_4.4H_2O$.

From solution (4) crop (a) seemed to be a mixture, yielding nothing definite; crop (b) consisted of crystals of $NaNH_4CrO_4.2H_2O$; crops (c) and (d) gave sodium chromate, $Na_2CrO_4.4H_2O$, differing from the ordinary chromate with ten molecules of water.

Solution (5) yielded first potassium bichromate and then a large number of crops of large flat hexagonal crystals which had the composition $3K_2CrO_4.Na_2CrO_4$

Solution (6) yielded no new compound, the two bichromates crystallizing out separately.

Solution (8) yielded a large number of crops of the double chromate of potassium and magnesium $K_2CrO_4.MgCrO_4.2H_2O$.

Solution (9) gave crystals of carbonate containing no chromium and also crystals of the salt $3K_2CrO_4.Na_2CrO_4$.

This work in the main confirms that of Zehenter though it introduces some new modes of formation of the double salts. It gave rise to some interesting questions though the time was too brief to answer them.

ORIGIN OF PALEOTROCHIS.[1]

BY J. S. DILLER.

Prof. Ebenezer Emmons,[2] while State Geologist of North Carolina, discovered among the so-called Taconic rocks of Montgomery County, in that State, a number of more or less regularly striated bi-conical forms to which he gave the names Paleotrochis major and minor, and regarded them as siliceous corals as well as the oldest representatives of animal life upon the globe. According to Emmons, Paleotrochis varies in size up to two inches in diameter, and occurs with many almond shaped concretions, often within concretions, in a series of beds over 1,000 feet in thickness interstratified with beds of granular quartz, conglomerate and quartzite.

[1] This paper is reprinted here from the American Journal of Science (May, 1899, page 337) as a substitute for an article which the present writer had intended publishing, setting forth the same general data and conclusions. Mr. Diller's work has removed all doubt as to the mineral origin of Paleotrochis; and the republication of his paper in the Mitchell Journal is considered advisable owing to the intimate association of the Paleotrochis with local North Carolina geology, and the previous publication in this journal of Mr. White's paper (see note below) which argued in favor of the organic origin of this interesting form.

[2] Geological Report of the Midland Counties of North Carolina, 1856, page 62; also Am. Jour. Sci., II, vol. xxii, page 390, and vol. xxiv, page 151.

Both species of Paleotrochis have the form of "a flattish double cone applied base to base" with the surfaces grooved somewhat irregularly from near the apex to the basal edge. The smaller form, P. minor, has the "apex of the inferior side excavated or provided with a small roundish cavity" and the other apex "supplied with a small rounded knob, from the base of which the radiated grooves begin." The larger form, P. major, "differs from the foregoing (P. minor) in the absence of the roundish apical depression of the lower side and the knob of the opposite side."

Prof. Emmons regarded Paleotrochis not only as originally siliceous but also gemmiferous, thus accounting for knobs as well as irregular adhering groups, and it is important to note that he reports "these fossils also occur in a variety of quartz or quartzite which I have described as a buhrstone, and which is often porphyrized."

Prof. James Hall,[1] after an examination of many specimens, regarded the Paleotrochis of Emmons as nothing but concretions in quartz rock. Prof. O. C. Marsh[2] examined the forms microscopically and found them composed of fine-grained quartz, but no trace of organic structure could be detected. While maintaining its inorganic nature he regarded it as difficult to explain, and considered it as having some analogy with cone-in-cone, which he thinks is probably due to the action of pressure on concretionary structure when forming.

The most extensive paper on this preplexing form is that of Mr. C. H. White,[3] who strongly advocates the organic nature of Paleotrochis. The specimens he examined were those obtained by Prof. Emmons, as well as a number collected by Prof. J. A. Holmes, the present State Geologist of North Carolina. Mr. White describes in detail not only the peculiarities of the weathered surface of the rock but also the features exhibited upon a fresh fracture, and called attention

[1] Am. Jour. Sci., II, vol. xxiii, page 278.

[2] Am. Jour. Sci., II, vol. xlv, page 218.

[3] This Journal 1894. Pt. 2, 50-66.

for the first time to the radial fibrous mineral which he regarded as impure chalcedony. According to Mr. White, the fossil forms are enveloped in chalcedony and the small concretions are made of the same material.

In 1887, Prof. J. A. Holmes[1] visited the Sam Christian Gold Mine of Montgomery County, N. C., and studied the Paleotrochis-bearing rock in the field. Although he had not then seen any of the acid volcanic rocks from New England, described by Dr. M. E. Wadsworth, or from the South Mountain region of Maryland and Pennsylvania, subsequently described by Dr. G. H. Williams and Miss Florence Bascom, he was of the opinion that the rocks in the neighborhood of the Sam Christian Gold Mine were of eruptive origin. Later observations have convinced him of the correctness of this view. The same opinion is entertained by Messrs. H. B. C. Nitze and George B. Hanna,[2] who consider the Paleotrochis-bearing rocks at the Sam Christian and Moratock Mines as ancient acid volcanics, and state that "it appears highly probable that at least some of these siliceous pebbly concretions are spherulites." Unfortunately in the preparation of their report time did not permit the authors to study thin sections.

The specimens which, at the request of Mr. C. D. Walcott, the Director of the U. S. Geological Survey, the present writer has had an opportuntity to study, consist of a small collection[3] from Mexico sent by Prof. H. S. Williams, besides three fragments about nine inches in diameter sent by Prof. J. A. Holmes, who collected them in 1887 at the Sam Christian Gold Mine, North Carolina, and from the same place several dozen of the original specimens of Paleotrochis major and minor collected by Prof. Emmons. Specimens of the rock and isolated fossils, excepting those from Mexico, have been cut and polished and thin sections prepared for microscopical study.

The rock from North Carolina which contains Paleotrochis

[1] Letter to the author Feb. 6, 1899.

[2] North Carolina Geological Survey, Bul. No. 3, pages 37 and 39.

[3] See Prof. Williams' article, *Am. J. Sci.*, *335*, 1899.

is full of nodules of various shapes and sizes, ranging from that of a pin's head to nearly two inches in diameter. These are the supposed concretions and fossils. Upon a fresh fracture the rock appears to be composed chiefly of quartz, but when weathered most of the nodules become white as if kaolinized, while the other nodules and the matrix remain quartzose in appearance. The nodules form at least two-thirds of the mass of the rock and are arranged with their longer diameters parallel, rendering the rock rather easily split in one direction.

With a lens, it may be seen that the small kaolinized nodules exposed in section upon the surface of a hand specimen have a radial fibrous structure. The same structure may be seen in some of the larger ones, and in addition to this feature some of the nodules possess a more or less distinct concentric shell-like structure. These structures are usually best displayed upon or close to a weathered surface. Portions of the nodules or spaces between them are in a few cases cellular, and the walls of the openings are rarely lined with minute crystals. The supposed fossil forms usually appear conical or discoidal upon a weathered surface. They often show a small cup in the apex and are surrounded by a narrow depression from which the radial fibrous envelope, pointed out by Mr. White, has been removed by weathering.

A careful comparative study of the nodules in the hand specimens tends to convince one that however different in form and size the supposed fossils and concretions may appear, all belong to one series and have essentially the same origin.

A microscopical study of thin sections of the rock reveals the fact that the nodules are spherulites, a common feature of acid igneous rocks. They are composed in most cases chiefly of fibrous feldspar with quartz or tridymite. As seen in the thin section of the Paleotrochis-bearing rock, the fibres are grouped radially with more or less irregularity in tufts, sheaves, sectors, hemispheres or spheres. When they form a complete sphere, which is rarely the case, they are most

coarsely fibrous or granophytic at the center and usually show between cross nicols an indefinite black cross. Occasionally also the concentric structure is well marked. The rays are too minute to permit of an accurate determination of their mineral composition by optical methods, but microchemical tests with hydrofluosilicic acid yield the small cubic crystals, characteristic of potassium fluosilicate as well as the hexagonal prisms of sodium fluosilicate. Judging from the greater abundance of prisms than cubes the fibrous feldspar is richer in sodium than potassium. That feldspar, instead of chalcedony, is the most prominent constituent of the spherulites, is fully borne out also by its kaolinizing under the influence of the weather.

The spherulites are embedded in a matrix composed chiefly of granular quartz. The grains are occasionally so large that the uniaxial positive character can be readily determined. Untwinned feldspar in small grains may be present in considerable amount but yet be easily overlooked. The quartzose character of the weathered matrix, however, shows that at least where most coarsely granular there cannot be much if any feldspar present in it. In places the matrix contains numerous minute parallel scales of what appears to be sericite. Associated with the most coarsely crystalline areas are a few scales of brown biotite and occasionally considerable green biotite, which in places is so abundant as to make quite prominent dark green spots. Both matrix and spherulites are traversed in a few cases by small veins of granular quartz, showing that there is a considerable amount of secondary quartz present. Both spherulites and matrix are rendered slightly microporphyritic by containing occasional crystals of plagioclase feldspar and quartz. The plagioclase, which, on account of its small angle of symmetric extinction, must be an acid one, in some cases forms the center from which the spherulitic fibres radiate.

An isolated specimen of Paleotrochis was cut through the apices and found to be composed of granular quartz. The quartz was fine-grained upon the outside where the grains

were set with their longest axes perpendicular to the adjoining surface. The middle portion contained an irregular iron-stained cavity possibly due to the disappearance of some iron-bearing mineral. Several of the half embedded forms of Paleotrochis were cut in a hand specimen to discover its relations to the enclosing rock, and in each case it formed the interior portion of a spherulite. Most of them contained a dark green patch. The exposed conical surface of one was well striated and there was an irregular depression in the apex. The form was composed chiefly of granular quartz with a yellowish brown to dark green, strongly pleochroic, biotite. Near the center is a small spherulite which is not only bordered by finer-grained quartz but is cut by a small vein of it, showing that the deposition of the quartz is subsequent to the development of the spherulite. The embedded portion of Paleotrochis is bordered by spherulitic fibres which run approximately parallel to the slope of the conical surface, and it is evident that the casts of these fibers produce the irregular striæ or grooves upon the surface of the supposed fossil. The embedded portion terminated with an irregularly-pointed apex below. The whole form is fine-grained near the border and sends small veins into the adjoining spherulitic shell. These veins are so small as not to be visible upon a polished surface of a hand specimen even with the aid of a pocket lens, but come out distinctly in the thin section. The spherulitic shell by which Paleotrochis is enveloped is composed of fibers belonging to a number of centers or lines and yet combined they appear to form one nodule. The biconical form of Paleotrochis suggests that it originated as two spherulite sectors of which the apices were the centers from which the fibres radiated. This would seem to be the simplest way to account for the most regular as well as many of the irregular forms, but of the specimens examined I have not been able to find one that certainly originated in that way.

A number of the fossil forms with a well-marked cup in the exposed apex turned out to be flat hemispherical or thin lenticular in section, and are composed wholly of spherulitic fibers.

Although admitting much irregularity, especially on account of the supposed gemmiferous character of Paleotrochis, the ones which have been considered the most characteristic of the fossil are the distinctly biconical forms. These, so far as seen, are chiefly granular quartz with more or less green biotite.

It is important to note also that the dark groups of green biotite occur in the interior of very irregular nodules which have no suggestion in them of Paleotrochis. Irregular flattened lenticular masses of granular quartz with green biotite occur within the spherulites as well as about them. The green mica is found only in the most coarsely granular groups of quartz.

The following chemical analysis, made by W, F. Hillebrand, shows that the rock has the composition of a rhyolite and accords closely with the results of the microscopical study.

Analysis of the Paleotrochis-bearing rock of Sam Christian Mine.[1]

SiO_2	79·57	
TiO_2	·11	
Al_2O_3	11.41	with a very little P_2O_5
Fe_2O_3	·20	
FeO	·70	
MnO	none	
CaO, SrO	·21	
BaO	.50	
MgO	a very little	
K_2O	3·52	
Na_2O	3·46	
H_2O below 105°	·18	
" above "	·61	(ignition)
	100·02	

Recognizing the Paleotrochis rock as an acid volcanic, full of spherulites, it is easy to understand the great variation in

[1] No other constituents looked for.

the form of the nodules. Such rocks are in many places distinctly banded and were long considered siliceous sediments, but by the investigations of Wadsworth, Williams, Bascom and others it has been definitely settled that they are all acid volcanics. These rocks in North Carolina are regarded by Mr. Holmes as pre-Cambrian and since their eruption may have undergone great changes like those of the South Mountain described by Miss Bascom. Some of the supposed fossils are certainly spherulites, and all of them may have been originally. Some broken forms show motion in the mass after the spherulites were developed. That Paleotrochis, where most perfectly developed and composed of granular quartz, is the result of deposition, after the spherulitic growths about it and within it had developed, there can be no question, but whether this deposition followed soon after that of the spherliutes in the course of solidification or took place in hollow spherulites (lithophysæ), or resulted perhaps long subsequently at the time of rock alterations, is not so clear. All this and much more will doubtless be cleared up by the members of the Geological Survey of North Carolina, who were the first to correctly identify the rock and the character of the supposed fossil.

None of the Mexican specimens received from Prof. Williams were cut for microscopical examination. Some of them were clearly of igneous origin, and contained amygdules. The Paleotrochis-like forms with radial markings appeared to be composed of secondary quartz and probably originated as those of North Carolina.

About a year ago bi-conical forms like Paleotrochis were presented by Mr. Kochibi, Director of the of the Geological Survey of Japan to the U. S. Geological Survey. These specimens are now in the National Museum, and are much more regular in form, size, and general appearance than the Paleothrochis of North Carolina. They are of a pale pink color with regular bi-conical, striated forms, and in some cases have shallow pits of the apices. They are known in Japan as "*Sorobanishi*" or abacus stones. One of these specimens con-

tains a small fragment of the rock from which these curious specimens were obtained, and it appears to be spherulitic. According to Mr. Willis, who obtained the information directly from Mr. Kochibi, "these stones are found only in rhyolitic tufts. They not infrequently occur much larger than these specimens, possibly up to two inches in diameter or more, and are more frequently associated in groups of two or three overlapping or coalescing. They are generally white, the rosy tint of these specimens being a rare characteristic." A thin section of one of these "abacus-stones" shows it to be an agate of which the outer layers are pink and the inner white. There can be no doubt in this case that the form resulted from the filling of the cavity long after the solidification of the igneous material.

THE DEEP WELL AT WILMINGTON, N. C.[1]

BY J. A. HOLMES.

The deep well which is now being bored at Wilmington, N. C., is of especial interest to geologists: (1) That in reaching granite, as it does at about 1109 feet, it shows the absence at this point of the formation between the upper Cretaceous and the old crystalline floor underlying the coastal plain deposits; (2) it shows the existence there of an unfortunately and unusually thick series of salt-water-bearing strata, from 350 to 1100 feet below the surface; (3) it may throw some light on the relations between the deposits of the sand hill regions (generally classed as Potomac) and the upper Cretaceous beds penetrated by this well.

The well is located on the bank of the northeast Cape Fear

[1] *Science*, N. S. XI., 265, Jan. 26, 1900, p. 128.

River, at Hilton Park, one mile north of Wilmington. The river border at this point exhibits two terraces; one only a few feet above tide water, extending back a distance of 30 or more feet from the river; and the other rising 30 to 40 feet higher, extending back for a considerable distance, and indeed representing the general surface of the region. The difference in elevation between these two terraces represents the thickness of the remnants of the Tertiary fossiliferous clays and limestone and the overlying recent sands. The lower terrace represents the upper surface of the Cretaceous; so that the well starts in the Cretaceous clays and sands, and continues in them to a depth of some 1109 feet. In these sands and clays there are occasional beds of shell-rock and calcareous sandstone, varying in thickness from a few inches to 30 feet, and occasional thin beds of clay containing small nodules or concretions. The sands are mostly micaceous and are usually quite fine grained, with a prevailing gray color. From about 700 to 800 feet, their color is decidedly greenish. Below 950 feet these sands become coarser and are interbedded with occasional gravel deposits, but they continue fossiliferous to near the surface of the granite.

Waterbearing sands and gravels were penetrated at a number of points, notably at 380, 496, 520 and 574 feet; and at 1011 the largest flow, of nearly 400 gallons per minute, was encountered, with pressure estimated as sufficient to raise the column of water 80 feet above the surface. Unfortunately the water from each of these levels was highly brackish, and hence unfit for domestic use.

The fossil forms secured at different depths have been identified by Dr. T. W. Stanton, of the United States Geological Survey. The method used in sinking the well is the ordinary drill and sand pump; and, as might be expected, in some cases only fragments of shells were secured; but as the hole was of large diameter (12 inches near the surface, then 10 inches, and lower still, 8 inches) and the larger part of the matrix material quite soft, a minimum amount of drilling was needed; and many large fragments and many perfect forms were obtained.

Among the fossils secured from the upper 700 feet, classed as Ripley cretaceous, the following may be mentioned:

Cardium enfaulense Gabb, was found at 40 feet and 538–558 feet, and fragments of this or another Cardium were found also at 50, 485–490, 520–540 and 556–575 feet below the surface.

Anomia argentaria Morton, was also common, having been obtained at frequent intervals from 40 to 600 feet; and fragments of an *anomia*, too small for specific classification, were also found 800 to 900 feet below the surface.

Exogyra costata Say, was abundant throughout the upper half of the section; and below 500 feet a varietal form of this species, approaching *Exogyra ponderosa* Roemer, in surface feature, was found almost to the granite.

Ostrea tecticosta Gabb, was common from 230 to 650 feet; and *O. larva* Lamarck, from 250 to 330 feet; and fragments secured at 518 feet probably belonged to one of these species. *O. subspatulata* Lyell & Forbes, was found only between 332 and 380 feet. Throughout the entire section, however, were found numerous fragments of *Ostrea* too imperfect to serve for specific determinations. *Veleda lintea* Conrad, and *Aphrodina tippana* Conrad (?) were found only at 340 to 500 feet. *Barbacoda arolinensis* Conrad, and *Cyprimeria depressa* Conrad, were found only between 332 and 380 feet; and fragments of *Pecten* were found at 40 to 50 feet.

Gryphaea vesicularis Lamarck, was found ai 250 to 265, and 720 to 735 feet (?); and *Inoceramus cripsii* Mantell, at 575 to 585 feet and probably also at 500 to 518 feet. Unrecognized species of *Avicula* or *Gervilia* were obtained at 390 to 400 feet; *Corbula* at 492; *Pectunculus* 520 to 540 feet, and *Lunatia* 520 to 590 feet; *Lithophagus* 540 to 560 feet.

Cassidulus subquadratus Conrad, was observed at 518 to 538 feet, and echinoid spines and fragments of the same or allied species were also found at 100 to 170 feet. Sharks' teeth, fish vertebræ, fragments of turtle shell, lignite and pyrite were found at intervals in the section.

Below 720 feet, and down to the granite (1109) *Ostrea cre-*

tacea Morton, which in the Chattahoochee river section is confined to the Eutaw beds, is here quite common; and is accompanied at intervals by *Anomia Exogyra*, *Cardium* and *Serpula*, the specimens collected being in each case too fragmental to permit of specific determination. This lower 400 feet of the Wilmington section has been classed by Stanton as *Eutaw*; and it is possibly the seaward representative of the Potomac arkose sands and clays of the sand-hill region northwest of Fayetteville, should these sands and clays prove to represent the latest Potomac. It is more likely, however, either that the Potomac deposits were removed from this region prior to the Eutaw deposition, or else that the surface of these old crystalline rocks was above water level during Potomac time, aud hence not covered with deposits.

Underground temperatures were not taken at intervals at different depths while the work was in progress, owing to the lack of suitable thermometers; but there are now three wells only three or four feet apart, one 1100, one 500 and one 100 feet deep. The temperatures at the bottom of each of these, as determined by the use of a Darton deep well thermometer, were found to be 79°, 72.50°, and 68.50°F. respectively, giving a descending increase in temperature of about 1°F. for each 100 feet, between 100 and 500 below the surface; and 1°F. for each 98 feet, between 500 feet and 1100 feet below the surface.

CHAPEL HILL, N. C.

NEW EAST AMERICAN SPECIES OF CRATAEGUS.

[1] CONTRIBUTIONS FROM MY HERBARIUM. NO. VI.

BY W. W. ASHE.

Crataegus pertomentosa n. sp. A small tree, 4–9 meters in height, with horizontal branches forming a round or flattened crown, trunk covered with gray bark broken into oblong

[1] Received Feb. 10, 1900.

scales, and often armed with long, gray or dark purple thorns: branches gray, armed with numerous 6–9 cm. long, dark red-brown purplish or nearly black, straight or slightly curved thorns: twig of the season glabrous brownish-red or brown: buds globular, red-brown, glabrous. Leaves broadly ovate or nearly orbicular, obtusely pointed at the apex, broadly cuneate, rounded or even subcordate at base, the blades 4–6 cm. long, 3–5 cm. wide with 5–7 pairs of prominent veins, acutely glandular serrate, doubly serrate or with 3–5 pairs of shallow lobes above, entire at the base, thick, subcoriaceous, dark green, glabrous and lucid above, paler and soft or roughish pubescent beneath: petiole 5–10 mm. long, margined above. The flowers are borne in 4–10-flowered compound tomentose corymbs, the lower branches from the upper leaves: fruiting pedicels strict, 2–4 cm. long pubescent: styles 3–4; stamens 10–15: calyx pubescent, its acute divisions entire or glandular laciniate. Fruit glabrous 8–13 mm. in diameter, red or yellowish: flesh thick: nutlets 3–4 with shallow furrows on the back.

This tree is related to *Crataegus tomentosa L.* from which it is separated by having smaller, broader and more pubescent leaves, fewer stamens and fewer-flowered corymbs. Type locality: Johnson county, Kansas, where I collected it last year. The type material is preserved in my herbarium.

Crataegus neo-fluvialis n. sp. A small tree 3–5 meters in height with long horizontal branches forming a flattened crown: branches gray, nearly straight or flexuous, armed with numerous slender, red-brown purplish or grayish, straight or slightly curved, 4–7 cm. long thorns: twig of the season red-brown, glabrous, marked with few pale ovate lenticels: winter-buds prominent, subglobose, red-brown, glabrous. Leaves lucid, dark green and nearly glabrous above, scarcely paler and pubescent to glabrate beneath, the pubescence soft and abundant on unfolding, becoming scanty and roughish with age, the blades elliptic or rhombic ovate in outline, 5–10 cm. long including the petiole, acute and entire towards the base which gradually narrows into the mar-

gined petiole, acute at the apex, finely and sharply glandular serrate, above the middle doubly serrate or with 2–3 pairs of shallow lateral lobes, 5–7 pairs of prominent straight parallel deeply impressed veins: petiole short, margined, glandless, 5–15 mm. long. The flowers are in large, 8–15-flowered, nearly glabrous, compound corymbs, the lower branches from the axils of the upper leaves: pedicels strict, 5-20 mm. long; stamens 10–15, longer than the 3–5 styles: divisions of the calyx lanceolate, 5 mm. long, sharply glandular serrate or entire. Fruit 6–9 mm. in diameter, nearly round, greenish, orange or rosy-cheeked, flesh thin and firm: seed 3-5, smooth or slightly ridged on the back, 4–5 mm. long, 3–4 mm. thick dorso-ventrally, the lateral faces concave.

Crataegus neo-fluvialis is related to *Crataegus macracantha Lodd.*, from which it is separated by having narrower acute pubescent leaves, and somewhat smaller fruit which lacks the bright red so characteristic of *Crataegus macracantha Lodd.* It is frequent along the North Fork of the New River in Ashe county, North Carolina, and the adjacent part of Virginia. The type material is preserved in my herbarium.

Crataegus Margaretta n. sp. A small tree 4–5 meters in height with rather short horizontal or ascending branches forming an open oval crown, or sometimes a large shrub: branches gray, flexuous or geniculate, unarmed thornless or sparingly beset with short, 2–3 cm. long, slender red-brown thorns, twig of the season geniculate, red-brown, glabrous, marked with numerous, very small gray lenticels: winter-buds subglobose, rather large, the few glabrous scales red-brown. Leaves glandless, glabrous, or at first with a few short hairs on the upper surface, membranaceous, or at length firmer, bright green on both sides, the blades broadly rhombic to nearly orbicular, or even broader than long, 3–5 cm. long, 2.5–6 cm. wide, with 3–6, generally 5 pairs of prominent straight veins, obtusely serrate and with 3-5 pairs of generally shallow lobes above the middle, or deeply lobed on vigorous shoots, obtusely or acutely pointed at the apex, entire or distantly serrate towards the obtuse or broadly wedge-

shaped base: petiole slender, 15–25 mm. long, narrowly winged above. The flowers which appear when the leaves are almost full grown in 7–12-flowered nearly simple corymbs, the lower branches from the axils of upper leaves, are white, 12–15 mm. wide and borne on strict glabrous pedicels 10–22 mm. long: petals orbicular, with a short claw, calyx glabrous, its divisions entire or sparingly serrate: styles 2–3 in number, 5 mm. long overtopping the 15–20 glabrous stamens: bractlets of corymbs and stipules of unfolding twig early deciduous, greenish, not conspicuously colored, spathulate, pectinately glandular. Fruit quite 1 cm. in diameter, nearly round, glabrous, fleshy, reddish or orange, persistent until late in the winter, on strict, slender pedicels: nutlets usually three, about 5 mm. long, the broad convex back deeply grooved and ridged. In eastern Missouri the flowers appear about the middle of May.

Crataegus Margaretta is found from eastern Iowa and southern Illinois to eastern Missouri, generally occurring along small streams. It is apparently related to *Crataegus punctata Jacq.*, from which it is distinguished by having fewer-flowered leafy corymbs, smaller fruit, and much broader leaves, which are pointed and have fewer pairs of prominent veins. The type material is preserved in my herbarium. The type locality St. Louis county, Mo.

Crataegus macrosperma n. sp. A small tree 5–7 meters in height, with wide-spreading branches, forming an oval or round crown, the trunk covered with gray-brown bark broken into small oblong scales: branches gray, armed with numerous short, very stout, 1–3 cm. long, dark red-brown or purplish to nearly black thorns: twig of the season rather thick, dark red-brown to purplish, sparingly glaucous glabrous, marked with a few small grayish lenticels; winter-buds rather large, oval or globular, dark red-brown, the obtuse or rounded scales glabrous. Leaves membranaceous but firm, dark green above, paler and sparingly glaucous or whitish beneath, the blades deltoid or broadly oval, obtuse at the apex, rounded, subcordate or on vigorous shoots cordate with a narrow sinus

at the base, varying greatly in size even on the same twig, 3–6 cm. long, 2–5 cm. wide, finely but sharply serrate to the base, doubly serrate or with 3–5 pairs of shallow lobes above, the serratures acutely gland-tipped, 4–6 pairs of prominent veins: petiole 1–2 cm. long, generally short and less than one-third the length of the blade, channeled, narrowly margined, at least above, and with a few glands near the base of the leaf. The flowers, which appear when the leaves are nearly grown in few 4–9–flowered nearly simple corymbs, are white 14–17 mm. wide and borne on slender pedicels: calyx glabrous, its divisions lanceolate, short, 3–5 mm. long, persistent and coloring with the fruit: styles 3–4: stamens 5–10, generally 5, the base of the very stout filaments persistent and coloring with the fruit. The fruit 13–18 mm. in diameter, borne in small clusters, is somewhat longer than thick, a uniform dark but bright red when ripe, glabrous and sometimes sparingly glaucous, flesh thick and mealy, pedicels strict and very slender generally falling with the fruit, which falls from the tree during the latter half of September: nutlets 3–5, deeply grooved and ridged on the back, 5–7 mm. long, 5 mm. thick dorso-ventrally, the lateral faces plane.

Crataegus macrosperma is found in northern Alabama and northwestern Georgia and the adjacent portions of Tennessee, growing frequently along rocky, especially cherty ridges in open woods, or often on exposed and thin-soiled almost untimbered rocks. It is frequent on Lookout Mountain, Tenn., which is the type locality, and where it was first collected by me in 1897, and on the surrounding mountains. This species is related to *Crataegus coccinea L.*, or more closely to *C. silvicola Bead.*, from which it is separated by having shorter stouter spines, smaller leaves, and much larger fruit. The type material is preserved in my herbarium.

Crataegus coccinioides n. sp. A small tree 4–6 meters in height with numerous spreading or ascending branches forming a round or oval crown: the gray bark of the trunk broken into small scales, often armed with long simple or compound

thorns: branches flexuous, dark gray, armed with numerous dark red or nearly black thorns, 2.5–5 cm. long: twig of the season glabrous, dark purple-brown, marked with a few pale, nearly orbicular lenticels: winter-buds small nearly globular, dark red, glabrous. Leaves glabrous, membranaceous, rather lax bright green above, scarcely paler beneath, the blades ovate, broadly oval or even isodimetric, 4.5–7 cm. long, 4–6.5 cm. wide, acute or obtuse at the apex, truncate, subcordate or on vigorous shoots cordate at the base with a broad open sinus, sharply and irregularly glandular serrate, above doubly serrate or with 3–4 pairs of shallow lateral lobes, entire towards the base, 4–6 pairs of prominent veins: petiole slender, terete, 2–6 cm. long, generally two-thirds the length of the blades, sometimes slightly margined and with a few glands near the base of the leaf. The flowers which expand when the leaves are scarcely half grown in small 5–8–flowered corymbs, are white, 18–20 mm. wide, and on slender 2–3–bracted pedicels: petals obovate 8–10 mm. long: styles 3–4, hairy at the base, shorter than the 20 stamens: calyx glabrous or minutely pubescent, its short divisions glandular serrate or laciniate. The fruit is 8–11 mm. thick, somewhat longer, bright red when mature and persistent until late in winter: nutlets 3–4, 5–6 mm. long, about 4 mm. thick dorso-ventrally, deeply sulcate and ridged on the back. Bracts and stipules lanceolate (lunate on vigorous shoots) glandular, bright colored, persistent until the flowers expand.

Crataegus coccinioides occurs along streams and in moist upland woods from southern Illinois to eastern Missouri. It is separated from the scarlet thorn by having larger leaves on longer petioles and larger fewer flowers. The type material is preserved in my herbarium.

Crataegus collicola n. sp. A small tree 5–8 meters in height with numerous wide-spreading or horizontal branches forming an oval or flattened crown, the gray bark of the trunk broken into flat, oblong scales and occasionally armed with long simple, gray thorns: the nearly straight gray branches armed with numerous, slender, gray or purple-brown, 4–8 cm. long

thorns : twig of the season glabrous, slender, dark brown-purple or gray, marked with few small pale indistinct lenticels : buds small, subglobular, brownish red. Leaves glabrous, at least when mature, firm, the larger ones becoming subcoriaceous, dark green above, somewhat paler beneath, the blades 4–6 cm. long, 2–4 cm. wide, oval and acute at the apex, or obovate and even spathulate and obtuse or rounded at the apex, tapering at the base into a short 5–15 mm. long, glandular margined petiole, or the larger leaves on vigorous shoots nearly orbicular, and abruptly contracted at the base, sharply and irregularly serrate to near the base or the larger leaves doubly serrate, or with 2–3 pairs of shallow lobes, 4–6 pairs of prominent veins : petiole broadly margined, at least above, 5–15 mm. long. The white flowers are borne in numerous, 6–14-flowered, compound, glabrous corymbs : divisions of the calyx lanceolate, acute, entire : styles 4–5. The abundant orange-red or dull red fruit is depressed globose, 8–11 mm. thick, about 8 mm. high : fruiting pedicels strict, 1–2 cm. long : nutlets 4–5, 5–6 mm. long, 3–4 mm. thick dorso-ventrally, slightly grooved on the back, the lateral faces nearly plane.

Crataegus collicola is related to the cockspur thorn from which, and all varieties of it, it is at once separated by having much broader often pointed and lobed leaves and much longer petioles. I collected this tree in the mountains of North Carolina in September, 1897 in Henderson county and near Asheville where it is found in fields and pastures on dry hillsides. The type material is preserved in my herbarium.

Crataegus Illinoiensis n. sp. A small tree with an oblong or irregular crown, or a tall shrub with virgate branches. Branches grayish-red or brownish, armed with 3–5 cm. long red-brown thorns. Twigs glabrous bright red-brown, as are the spherical buds. Leaf-blades 5–8 cm. long 4–8 cm. wide, nearly obicular or slightly obovate and broadly wedge-shaped at the base, obtuse or rounded at the apex, very sharply and glandular doubly serrate, or somewhat 3–7-lobed above, 4–6 pairs of prominent veins, minutely appressed pubescent above, pubescent beneath with rather harsh, short spreadin

hairs: petioles .5–1.5 cm. long, margined above, deeply channeled. The inflorescence is in loose, 7–18–flowered, compound corymbs, the branches 1–3–flowered, the lower from the axils of the upper leaves. The flowers, appearing the latter part of May when the leaves are nearly full grown, are white, 1.5–1.7 cm. wide: petals nearly orbicular, abruptly contracted into a short claw: stamens 7–10, the glabrous filiments 7–8 mm. long, enlarged at the base, one third longer than the 3 stout glabrous styles: calyx tube obconic, 4–6 mm. long, pubescent with spreading hairs, the lanceolate divisions deeply lacinate, appressed pubescent, the serratures gland-tipped: pedicels pubescent, stout, .3–2 cm. long: bracts linear, small, inconspicuous, early deciduous. The fruit, persisting until late in winter, is 8–11 mm. thick, bright red, nearly glabrous, the flesh rather thin and firm: seed 2–4, about 4 mm. long, somewhat grooved and ridged on the back, the lateral faces plane.

This species is related to *C. Biltmoreana Bead.* from which it is separated by having much rounder leaves, larger compound corymbs, and bright red glabrous fruit. Open woods, central Illinois. I refer here to material collected at Wady Petra, Ill., by V. H. Chase, and distributed as *C. macracantha.*

Crataegus pulcherrima n. sp. A small tree 3–4 metersp in height. Twigs very slender, 2–3 mm. thick, red-purple, glabrous. Leaf-blades 2–4.5 cm. long, oval to nearly orbicular in outline, 3–7-notched above, glandular-denticulate or distantly serrate, obtuse or acute at the entire base, membranaceous, bright green and glabrous on both sides, with 4-6 pairs of prominent veins: petiole .5–2 cm. long, very slender, winged above, roughed with 1–2 pairs of sessile glands. Flowers white, in glabrous, few-flowered, nearly simple corymbs: pedicels .7–1.5 cm. long, glabrous, strict: stamens 10, styles 4–5, calyx divisions, acute, entire, deciduous. Fruit glabrous, yellowish or reddish, 5–7 mm. thick, 6–8 mm. long: seed 4–5, 3–4 mm. long, smooth on the back and the lateral faces plane.

A very distinct species. Southwestern Georgia, and northwestern Florida. Here I refer Nos. 2568 and 2377 G. V. Nash, 1895.

Crataegus Holmesiana n. sp. A small tree 3--5 metres in height, with a rounded or flattened crown and long horizontal or spreading branches armed with numerous 3--4 cm. long straight or slightly curved thorns; or generally a large shrub. Leaves ovate, the blades 4--9 cm. long, 3--6 cm. wide, obtuse or acute at the apex, acute, obtuse or somewhat rounded at the base, coarsely and acuminately serrate all around, the teeth gland-tipped with 5--9 pairs of shallow lobes or doubly serrate, 5--7 pairs of prominent veins, glabrous on both sides or when young sparingly pubescent beneath: petioles terete, slender, 1.5--3 cm. long, generally purplish, and with a few stalked glands on it near the base of the leaf. Flowers in glabrous, nearly simple few-flowered corymbs, white, 1.5--1.7 cm. wide: petals nearly orbicular contracted at base into a short claw: calyx glabrous, the divisions glabrous, nearly entire; bracts and bractlets few, linear, glandular, not conspicuous. Fruit 8--11 mm. thick, red, glabrous, falling early, 3--5 seeded.

This species in its habit resembles *C. mollis*. It is separated from the nearly related species of the *coccinea* group by having much larger leaves with very acute serratures. Central New York.

Crataegus atrorubens n. sp. A small tree or shrub. Branches gray: twigs bright red-brown, rather slender, marked with few pale lenticels: thorns few. Leaves oval, broadly ovate, or even obovate, the blades 3--7 cm. long, 2--5 cm. wide, obtusely and rather coarsely serrate, sometimes with 3--5, shallow lobes towards the obtuse apex, or merely doubly serrate, 4--6 pairs of prominent veins, entire at the rounded or subcordate base, dark green above, slightly paler beneath, membranaceous, when young sprinkled with short appressed hairs on the upper surface, especially on the veins, and pubescent beneath in the axils of the veins, at length glabrate: petioles 1.5--3 cm. long, very slender, finely pubescent, especially on the grooved upper surface. Inflorescence a 6--14-flowered

loose compound corymb, the glabrous branches generally 3-flowered: pedicels finely pubescent, bearing 1--2 filiform glandless bractlets, the bracts of the branches very few, inconspicuous, spathulate, entire, or minutely glandular denticulate: flowers white 1.5 cm. wide: petals orbicular: calyx soft pubescent, the acute divisions entire: stamens 20, scarcely longer than the 4--5 styles. Fruit globular, 9--11 mm. thick, dark red, glabrous.

Distinguished from *C. coccinea* by having more entire leaves, and being pubescent. St. Louis County, Missouri.

Crataegus polybracteata n. sp. A shrub or small flat-topped tree with spreading branches. Twigs glabrous, armed with stout curved purple-black thorns. Leaves ovate or elliptic, the blades 3--6 cm. long, 2--4 cm. wide, glandular serrate, with 3--7 shallow lobes, or doubly serrate, acute at the apex, acute or obtuse at the entire base, glabrous on both sides: petiole slender, 1--2 cm. long, narrowly margined above. Inflorescense a 4--10-flowered nearly simple corymb, the branches and stout 1--2 cm. long pedicels glandular dotted, and pubescent with rough spreading hairs: branches and pedicels with linear, spathulate, or deeply 3 parted, .5--2 cm. long bracts, which are rough hairy, pectinately glandular, and persist until after the petals fall. Flowers white, 2--2.5 cm. wide: stamens about 15: styles 3--4: calyx pubescent with a few short, spreading hairs: the divisions 4--6 long, pubescent, glandular serrate. The dull red glabrous fruit is 8--11 mm, in diameter and is borne on strict pedicels.

This species is related to *C. rotundifolia* from which it is separated by having smaller more simple corymbs, larger flowers with hairy pedicels. and large persistent glandular bractlets. Ohio to New York. The type is preserved in my herbarium.

NOTE ON A QUALITATIVE TEST FOR TIN.[1]

BY CHARLES BASKERVILLE.

Scarcely any instructor in Qualitative Analysis has failed to have difficulty in having his students make a satisfactory separation of arsenic, antimony and tin. Either of the ordinary methods of separation of the arsenic, namely, solution of arsenic sulphide in ammonium carbonate or the solution of the mixed sulphides of tin and antimony in hot concentrated hydrochloric acid, answer very well for the arsenic. The presence of antimony in the hydrochloric acid solution is easily proven by its precipitation upon platinum in the presence of metallic zinc, subsequent solution in dilute nitric or tartaric acid, and so on. The difficulty is in proving the presence of tin. Unless most of the acid has been driven off and the solution well diluted the tin fails to be precipitated on the zinc. We have usually tested the solution directly with mercuric chloride and hydrogen sulphide for tin. These tests are not always satisfactory, more or less doubt existing in the student's mind, especially if all the antimony has not been removed.

Longstaff (*Chem. News*, *80*, *282*) suggests reversing the test given by Fresenius (Qual. Anal., 8th Edit., p. 217, trans. by Johnson) for molybdic acid. Stannous chloride produces a blue coloration with molybdic acid. He uses ammonium molybdate.

We carry out the test as follows: filter from the diluted liquid any remaining particles of zinc and add a pinch of powdered molybdic acid. A deep blue color shows the presence of tin. We have proved the presence of one part in five thousand with the very roughest conditions under which a most careless student may work. Longstaff states that with every precaution for exclusion of air it is delicate for one part in a million. The color disappears in the presence of concentrated hydrochloric acid.

The presence of arsenic, antimony and zinc compounds has

[1] Read at the Midwinter Meeting of the North Carolina Section of the American Chemical Society February 24th, 1900.

no effect on the molybdic acid. Care should be taken, however, that no small particles of zinc pass into the liquid after filtering, for the nascent hydrogen generated gives the same color reaction.

February 1900.

UNIVERSITY OF NORTH CAROLINA.

NOTE ON A CASE OF SPONTANEOUS COMBUSTION.[1]

BY CHARES BASKERVILLE.

In August 1898 a fire occurred in some of the dyed warp of one of the largest cotton mills in this State. Samples of all materials used in the dyeing and sizing of the yarn were sent the writer by the proprietors of the mill with instructions to seek the cause of the fire in detail. Fortunately, as later learned, the fire was discovered in time and extinguished, avoiding very serious consequences. Such a fire was unusual with these mill owners, the first, in fact, in the history of the mill in question, and its recurrence might prove disastrous. It was necessary to learn if some irregularity in the practice or material used could have been the cause or whether it resulted from the action of chemicals surreptitiously placed upon the yarn by some ill intentioned operative.

Their customary procedure was to dye eight warps at a time (1040 lbs.) in a dye bath of two hundred and fifty gallons of water into which have been placed for each one hundred pounds of yarn eight ounces naphthazarin L. W., five pounds sal soda, one half pound Marseilles soap and six pounds salt. The bath was gradually increased to three hundred gallons and then run off. The warps were then washed with three hundred gallons of water at 180° F. and sized.

[1] Read before Midwinter Meeting of North Carolina Section of the American Chemical Society, 1899.

For sizing each one hundred pounds of yarn nine pounds of starch and three pounds of tallow were used. The warps were run off the dyeing cylinders into sacks quite hot and stored away. At the time mentioned these warps were stored away at four oclock in the afternoon. The fire was discovered at one the next morning.

Enquiry elicited these facts; first fire; all materials had been on hand some time; same dye had been used for long time; no recent new purchase of dye; *the mill shut down for repairs immediately after the the dyeing and before the sizing of the warps which caught fire.*

Careful microscopic examination of the yarn showed only such changes in the fibre as resulted from the mechanical strain to which it had been subjected in the spinning and an even distribution of the dye. No spotted effect was observed such as would occur if chemicals in careless or ignorant hands had been placed upon the yarn intentionally or by accident.

The dye used is commercially called "naphthazarin L. W." By analysis and investigation of the patent literature it was found to be a mixture of equi-molecular parts of tetrazo-diphenyl, sodium salt of amido-naphthol disulphonic acid and dihydroxynaphthalene precipitated by and incorporating more or less sodium chloride. The tetrazo bodies under certain conditions, namely, acid, liberate oxides of nitrogen which may oxidize such substances as cotton. No acid was used according to the dyeing formula.

Fires have frequently resulted from the oxidation of fats, as when old greasy rags are packed away in a warm place for a long while. According to the ordinary method of dyeing as practiced in this mill the rapidity of the work does not give time necessary for oxidation which produces heat. In this case two weeks intervened and the tallow used in finishing either being on hand and exposed more or less to the atmosphere during a warm season permitting the oxidation to begin became rancid, or it was purchased rancid. The oxidation of the fatty constituents of tallow once begun con-

tinues with greater rapidity the better the conditions, namely heat, which conditions prevailed in this case.

The tallow used melted at 42° C. Normal tallow melts at from 43° to 46° C. The amount of lard present was therefore comparatively small. The tallow was rancid, reacting acid with litmus paper.

A chemical examination of the burnt portion showed the presence of nitric acid. This would have resulted from the decomposition of the dye which contains much nitrogen. Nitric acid was also detected in other portions of the material *not* charred, showing that the dye had been decomposed partially by the rancid fat, but not to such an extent as where the burning occurred.

The dyeing was done in an alkaline bath (soda) to prevent this decomposition. The excess of this alkali is washed out and then the warp is sized. Rancid fat is acid and the acidity is increased by further oxidation of the fat, especially at the temperature named. This acid is liable to decompose the dye containing azo radicals liberating the oxides of nitrogen, which tend to increase the oxidation. Experimental proof of this was obtained. The warps being confined instead of cooling nurse the heat until the temperature rises to the charring point of cotton. These conditions being allowed to continue fire would result, as happened in this instance.

As stated above, while it is possible that gaseous compounds capable of burning cotton could come from the dye, it is probably not the case here. Certainly there is no danger if the tallow is fresh. The fire therefore may be attributed to the spontaneous combustion produced by the continued oxidation of rancid tallow. The fact that it was rancid was evidence that the oxidation had begun. Tallow that is only slightly rancid may be used with comparative safety when the process is rapidly carried out. The only absolutely safe plan however is to use fresh tallow. The rancidity of tallow shows itself by acid reaction to litmus paper.

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SOME DICHOTOMOUS SPECIES OF PANICUM.

[1] CONTRIBUTIONS FROM MY HERBARIUM. NO. VII.

W. W. ASHE.

PANICUM ALBEMARLENSE n. sp. A densely tufted perennial, dark green or purplish in color, 2–3 dm. high. Culms erect, strict, slender, villous with spreading or ascending 3–4 mm. long white hairs, leafy to near the top, barbed at the nodes: internodes much longer than the leaves and sheaths. Stem-leaves 3–5, firm, erect, 2–5 cm. long, 3–4 mm. wide, the longest near the middle of the stem, very gradually tapering to the apex from near the rounded base, pubescent above with long spreading white hairs, especially towards the base, mixed with shorter ones, pubescent beneath with short ascending hairs, the margins very rough and ciliate at the base with a few long hairs: ligule of a few 2 mm. long hairs; basal leaves 1–2 cm. long, 4–7 mm. wide, glabrate, at least when old. Primary panicle 2–4 cm. long, 1.5–3 cm. wide, the numerous branches ascending, on a short peduncle, 1–4 cm. long, or barely exserted: spikelets broadly obovate, 1.5 mm. long, 1.2 mm. wide, first scale acute, one-third the length of the strongly 7–9–nerved second and third scales, which are pubescent with spreading hairs.

PANICUM ALBEMARLENSE is very common in well drained open woods in Beaufort and Hyde counties, N. C., where the type material was collected by me May 26, 1899, near Scranton. It has the same habit and is closely related in character to *P. meridionale* Ashe, from which separated by being larger, having shorter pubescence, and larger spikelets.

I find that there has been previous use of a very similar name or of the same name which I have applied to the three following species of Panicum,[2] so I propose the following changes in their names:

PANICUM SHALLOTTE n. nom. *P. glabrissimum* Ashe, not *P. glaberrimum* Steud.

[1] Received Feb. 19, 1900.

[2] Jour. Elisha Mitch. Sci. Soc. 15, part 1, 1898.

PANICUM YADKINENSE n. nom. *P. maculatum* Ashe, not *P. maculatum* Aubl.

PANICUM BOGUEANUM n. nom. *P. annulum* Ashe, not *P. annulatum* A. Rich.

PANICUM AUSTRO-MONTANUM n. sp. A tufted perennial 1.5–2.5 dm. high. Culms very slender, erect, glabrous. Leaves of stem 2-4, spreading, .5–1.5 cm. long, 3–4 mm. wide, broadly lanceolate, narrowed or rounded at the base, light green, thin and soft; basal leaves numerous, somewhat longer than those of the stem: ligule a ring of hairs about 2 mm long: sheaths very short, one-fourth to one-half the length of the internodes, generally about the length of the leaves, at least the lower pubescent, especially at the throat, with soft spreading hairs 2 mm. long, nodes barbed with soft spreading hairs. Panicle short-peduncled, 1–2 cm. long, and somewhat narrower, the branches spreading: spikelets broadly obovate, .7 mm. long, first scale one-third the length of the faintly 5–nerved glabrous second and third.

This species is related to *P. Cuthbertii* Ashe, from which separated by having pubescent sheaths and broader spikelets; and to *P. curtifolium* Nash, from which it is separated by having much shorter leaves and smaller spikelets. Along mountain streams of northern Alabama and the adjacent parts of Tennessee. Type material is preserved in my herbarium.

PANICUM CURTIVAGINUM n. sp. A tufted perennial. Culms glabrous, very slender, erect, 4–6 dm. high. Stem leaves 4–6, narrowly lanceolate, 4–8 cm. long, 3–5 mm. wide, the upper reduced in size, soft and thin, bright green, glabrous, except for a few 3–4 mm. long cilia at the base of the lower ones, faintly nerved, narrowed to the base, long taper-pointed, spreading or ascending; basal leaves somewhat longer and wider: internoded much longer than the leaves and sheaths, leaves longer than the sheaths: sheaths glabrous: ligule pubescent with white hairs about 1 mm. long. Panicle long-exserted, 3–6 cm. long, 2–3 cm. wide, the numerous branches ascending: spikelets broadly elliptic, quite 1.5 mm.

long, 1 mm. wide, abruptly acute, first scale 1-nerved, glabrous, one-fourth to one-third the length of the strongly 5–7-nerved thin glabrous second and third.

Collected at Petit Bois Island, Mississippi, May 8, 1898, by S. M. Tracy.

PANICUM WILMINGTONENSE n. sp. Perennial growing in small tufts. Culms very slender, erect, 3–4 dm. high, geniculate, pubescent, at least below, with short ascending hairs or above glabrate, at first simple, at length much branched: sheaths close-fitting, pubescent with short ascending hairs, one-half the length of the internodes or less: ligule a row of short white hairs about 1 mm. long. Stem leaves 3–4, shorter than the internodes, 3–6 cm. long, 3–5 mm. wide, broadest near the base, very long taper-pointed, slightly rounded at the base, glabrate or pubescent beneath with short ascending hairs or with a few long hairs on the margin near the base, thick and firm, the margins rough, white and thickened, upper leaves reduced in size: basal leaves equaling the lower stem leaves. Panicle ovate, 3–4 cm. wide, 5–7 cm. long, branches few, at least the lower ascending: spikelets broadly obovate, quite 2 mm. long, nearly glabrous, the 1-nerved first scale, about one-third the length of the glabrate 7-nerved second and third.

Panicum Wilmingtonense is closely related to *P. Atlanticum* but has smaller more acute spikelets, a more slender culm, scantier pubescence and smaller leaves. The type material collected in May, 1899 on the sand hills near Wilmington, N. C., is preserved in my herbarium.

PANICUM SUBVILLOSUM n. sp. A densely tufted perennial, 1.5–3 dm. high. Culms very slender, glabrous above, below pubescent with ascending hairs. Stem leaves 3–5, erect or ascending, lanceolate or narrower, 3–4 cm. long, 3–5 mm. wide, long taper-pointed, rounded at the base, nearly glabrous beneath, above pubescent with long white ascending hairs, margins rough, ciliate, at least near the base with long white hairs, upper stem leaves and basal leaves reduced in size: ligule pubescent with white hairs 2 mm. long: sheaths

pubescent with spreading hairs, much shorter than the internodes. Panicle on a long peduncle, 6–12 cm. long, broadly oval, 2–3 cm. long, 1.5–2.5 cm. wide, branches glabrous, spreading: spikelets broadly obovate, 1.5 mm. long glabrous, the obtuse first scale one third the length of the firm 7-nerved second and third.

Collected by the writer at Carlton, Minnesota, in August, in the simple state. Type material preserved in my herbarium.

PANICUM PARVIPANICULATUM n. sp. A densely tufted perennial, perfectly glabrous except the ligule. Culms 2–3.5 dm. high, erect, at length sparingly fasciculately branched and more or less reclining. Stem leaves 3–5, distant, spreading or the upper erect, very much shorter than the sheaths, one-fifth to one-third the length of the internodes, 1–2 cm. long, 2–3 mm. wide, lanceolate, the upper reduced in size, soft, but rough on the upper surface: ligule densely pubescent with hairs about 2 mm. long: basal leaves numerous, tufted, remaining green until after flowering, 2–4 cm. long, 4–5 mm. wide. Panicle exserted on a peduncle 3–5 cm. long, small, broadly ovate, 2–3 cm. long, 1.7–2.5 cm. wide, branches few, horizontal or at length strongly reflexed, spikelets elliptic, acute at both ends, glabrous, barely 1 mm. long, pedicels divaricate, first scale ovate, acute, scarcely one-fourth as long as the thin faintly 7-nerved second and third.

Panicum parvipaniculatum is related to *P. lucidum* from which it is separated by having somewhat smaller spikelets, smaller leaves and glabrous sheaths, and an erect habit. It begins to flower about two weeks earlier than *C. lucidum*. Collected May 20, in Onslow county, N. C. Type material is preserved in my herbarium.

PANICUM PAUCICILIATUM n. sp. A perennial forming small or large tufts. Culms 2–3 dm. long, rising from a geniculate base or reclining, at first simple at length much branched, reddish or purplish, slender, glabrous or the lower internodes puberulent. Stem leaves 3–4, lanceolate, 2–5 cm. long, 4–6 mm. wide, spreading or ascending: glabrous or with a few

stiff white cilia on the margin near the base: sheaths somewhat loose, often purplish, the lower less than one-half the length of the internodes: ligule none. Panicle 3–7 cm. long, broadly oval, the few branches spreading: spikelets 1.5 mm. long, obovate, obtuse, contracted at the base, the first scale very obtuse, nearly orbicular, about one-third the length of the nearly glabrous obtuse second and third.

This species is closely related to *P. demissum*, from which it is separated by having smaller and more numerous spikelets. Collected by me May 20, 1899, growing in dry sand near Wilmington, N. C.

PANICUM ONSLOWENSE n. sp. A perennial growing in small tufts. Stems 2.5–3.5 cm. high, erect or rising from a geniculate base, glabrous. Stem leaves 3–5, 2–4 cm. long, 3–5 mm. wide, lanceolate, narrowed at the base, the upper reduced in size, erect or ascending, glabrous except a few short 2–3 mm. long cilia on the margin at the base, the edges white and roughened: basal leaves much longer and broader, sometimes 6 cm. long and 1 cm. wide: ligule none: sheaths glabrous, sheaths with the leaves shorter than the internodes. Panicle broadly ovate, 4–6 cm. long: branches few, fascicled, spreading very rough: peduncle 1–2 times the length of the panicle: spikelets very short-pedicled, elliptic, acute at both ends, 2–2.5 mm. long, the very thin obtuse first scale one-third to one-half the length of the strongly 7-nerved glabrous second and third.

Panicum Onslowense occurs in the flat woods and savannas near the coast in the southeastern part of North Carolina and the adjacent parts of South Carolina. It is not uncommon in the eastern part of Onslow county, N. C., where the type material was collected near Ward's Mill. It is related to *P. Nashianum* and *P. demissum*, from both of which it is separated by having acute spikelets and an erect habit.

PANICUM FILIRAMUM n. sp. A perennial with 2–5 stems from the same root. Stems very slender, simple, ascending or spreading, at length much branched and reclining, 4–7 dm. long, pubescent at least below with short spreading or ascending hairs about 2 mm. long. Stem leaves 2–6 cm. long,

2–4 mm. wide, the upper very short, rather thin, narrowed at the base, ascending, pubescent especially on the lower surface and towards the base with spreading hairs, or glabrous: ligule villous with white hairs 3 mm. long: sheaths pubescent with spreading or ascending hairs 1–2 mm. long, especially at the throat: nodes barbed: basal leaves glabrate, much broader and shorter than the lower stem leaves. Panicle 4–6 dm. long, oval, the branches horizontal, glabrous: spikelets numerous, on very slender spreading pedicels, broadly obovate, 1.5 mm. long, first scale very obtuse, about one-third the length of the pubescent 5–7 nerved second and third.

This species is related to *P. arenicolum* and *P. arenicoloides*, but is separated from both by having very much smaller spikelets. Habitat: sandy woods, eastern North Carolina. Type material collected in New Hanover county, N. C., in June 1899.

PANICUM ARENICOLOIDES n. sp. A perennial with 2–5 stems from the same root. Stems very slender, simple, ascending from a geniculate base, or at length much branched and spreading, 4–7 dm. long, pubescent, at least below, with 3–4 mm. long spreading white hairs, or merely puberulent, glabrate above. Stem leaves 5–8, spreading or ascending, 4–11 cm. long, 2–4 mm. wide, narrowed at the base, pubescent, especially near the base, with 3–4 mm. long spreading white hairs, or glabrate, the longest one-third above base of stem, upper much narrowed and shorter: basal leaves much broader and shorter: ligule of dense white hairs about 1 mm. long: sheaths one-third to one-half the length of the internodes, which are generally somewhat longer than the leaves, pubescent, especially the lower, or glabrate. Panicle 5–7 cm. long, 2–5 cm. wide, the rather few flexuous branches erect or ascending: spikelets obovate, 2–2.2 mm. long, abruptly acute, contracted at the base, first scale acute, one-third the length of the strongly 7-nerved very pubescent second and third: peduncle about the length of the panicle.

Habitat: shady sandy woods along the coast of North Carolina. Type material collected by me near Wilmington, N. C., June 6, 1899. This species is intermediate in many

ways between *P. arenicolum* and *P. neuranthum*. The very long narrow stem leaves and the pubescence of the plant are distinctive, however.

PANICUM ORTHOPHYLLUM n. sp. A somewhat tufted perennial. Stems strict, erect, glabrous, or pubescent with ascending hairs, 4–6 dm. high, primary stem leaves somewhat narrowed to the base, erect, glabrous or nearly so, 5–8 cm. long, 3–5 mm. wide: sheaths appressed pubescent or glabrous with a few cilia near the throat, shorter than the internodes, or the later crowded and overlapping: secondary leaves much narrower: ligule a ring of hairs 1–2 mm. long: basal leaves few, much shorter and broader. Panicle long-peduncled, ovate, the few branches erect, ascending or spreading, glabrous: spikelets barely 2 mm. long, broadly obovate, very obtuse, first scale small, obtuse, about one-fourth the length of the sparingly pubescent strongly 7-nerved second and third.

Shady slopes of sand hills, New Hanover county, N. C., June 1899. Related to *P. angustifolium* and *P. neuranthum*, from which separated by having smaller obovate spikelets.

PANICUM ERYTHROCARPON n. sp. A somewhat tufted perennial. Stem stout, erect, 4–6 dm. high, pubescent, at least below, with soft appressed or ascending hairs. Primary stem-leaves spreading or erect, 4–7 cm. long, 4–8 mm. wide, lanceolate, rounded or narrowed at the base, long taper-pointed, pubescent on both sides with appressed hairs, often mixed with long spreading hairs towards the base on the upper side, margins ciliate at the base: ligule pilose: sheaths appressed pubescent, often nearly as long as the internodes. Panicle 7–12 cm. long, 6–14 cm. wide, on a peduncle of about its length, the numerous fascicled branches spreading or drooping. Spikelets 2.5–3 mm. long, elliptic, acute, generally bright red, the first scale very acute, nearly one half as long as the pubescent 7-nerved second and third.

This plant is separated from *P. pubescens*, which it resembles, by having larger spikelets and ascending pubescence, and from *P. haemacarpon* by having larger spikelets, a more ample panicle, and much greater size.

The type material was collected by the writer on the sand hills of New Hanover county, N. C., May 19, 1899.

PANICUM MISSISSIPPIENSE n. sp. A tufted perennial 3–4 dm. high. Stems erect, glabrous or nearly so, often papillate below, at first simple, at length branched especially from the lower nodes. Primary stem leaves 3–7 cm. long, 3–7 mm. wide, rounded at the sparingly ciliate base, otherwise glabrous, rough on the margin: ligule a mere margin: sheaths much shorter than the internodes, papillate, glabrous except the edge which is finely ciliate with hairs 1–2 mm. long: basal leaves few and short, Panicle oblong, 3–5 cm. long, glabrous, on a peduncle 2–3 times its length, the mostly single branches short and horizontal: spikelets glabrous, nearly orbicular, 1.2 mm. long, 1 mm. wide, the nearly orbicular first scale, one-third the length of the very thin faintly 5-nerved, glabrous second and third: later panicles exserted on short peduncles.

A very distinct species. Collected by me on the banks of the Mississippi river below New Orleans in October. I also refer here S. M. Tracy's No. 6777, collected on Horne Island, Miss., in July 1899.

PANICUM TAXODIORUM n. sp. A very slender perennial, 4–7 dm. high, at first simple and erect, at length spreading and loosely branched. Leaves very thin, glabrous, dark green, the edges very rough, 4–10 long, 3–5 mm. wide, narrowly lanceolate, narrowed to the scarcely rounded base, long taper-pointed: ligule none: sheaths glabrous except the finely ciliate margins, or with a few long hairs at the throat: basal leaves, in the specimen at hand very short, and few. Panicle 6–10 cm. long, ovate, the branches few, slender, fascicled, ascending: spikelets full 2 mm, long, elliptic or obovate, acute, glabrous, short-pedicled.

This species is related to *P. dichotomum* but differs in the panicle having fewer, ascending branches, acuter spikelets, narrower leaves, and in having the secondary panicles exserted.

Type: K. K. McKenzie's No. 460. Hummocks in cypress swamps. Lake Charles, La., September 1890.

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